Effectiveness of Neuromuscular and Functional Task Training in Subjects with Osteoarthritis of Knee: A Comparative Study

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Abstract

Background and Objective: Knee Osteoarthritis is the most prevalent and leading cause of pain and disability which is leading to functional limitation and reduced quality of life. The rate of prevalence in India it is 22-39%. Evidence suggests that Neuromuscular and Functional Task Training may be the best way to treat knee Osteoarthritis. Hence from the above literature, both the interventions are effective in improving strength and function in subjects with Knee Osteoarthritis and literature is limited on their comparison.

Method: 150 subjects who were clinically diagnosed of Osteoarthritis of knee were assessed and only 68 were recruited who are willing to be in the study and they were randomly allocated into two groups. In Group I (n=34) subjects were received neuromuscular training, where in Group II (n=34) subjects were received functional task training for 8 weeks. The outcomes of this intervention were knee pain and function using disability index (KOOS) and DYNAMOMETER for limb strength (knee flexors and extensors).

Results: Statistical analysis of the data revealed that in between group comparison showed there is a STATASTICAL significant difference in KOOS and Knee Flexors and Extensors strength

Conclusion: In the present study Neuromuscular training is more effective in improving strength and function when compared with Functional Task Training. Thus we can conclude that Neuromuscular Training is a suitable adjunct to physiotherapy rehabilitation in subjects with knee Osteoarthritis

Key words: *Knee Osteoarthritis, strength, KOOS, ADL, QOL, Neuromuscular Training, Functional Task Training.*

Introduction

Knee Osteoarthritis is a degenerative joint disease, which alters the structure of the cartilage[1]. Knee is the most commonly affected joint by Osteoarthritis [2]. Knee Osteoarthritis is the most prevalent and leading cause of pain and disability in most countries worldwide. The prevalence increases with age and affects generally women than men. Worldwide prevalence of knee Osteoarthritis is 3.3% and in India it is 22-39%. In Andhrapradesh knee Osteoarthritis is 68% [3,4]

The etiologies of Osteoarthritis are to be multifactorial which includes genetic, environmental, metabolic and biomechanical. Osteoarthritis is classified into primary and secondary. The cause of primary Osteoarthritis is idiopathic and the cause of secondary Osteoarthritis is any underlying primary disease of joint which leads to degeneration [5].

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In Osteoarthritis the pathophysiology of articular cartilage is played by cell or extra cellular matrix (ECM) interactions which are mediated by cell surface integrins.. In Osteoarthritis abnormal integrin expression alters cell or ECM signaling and modifies chondrocyte synthesis, imbalance of destructive cytokines over regulatory factors. IL-1, TNF- alpha and other procatabolic cytokines activate the enzamatic degradation of cartilage matrix [6]

Pain is the dominant symptom of Osteoarthritis which affects crucial functional activities like walking and other associated symptoms are stiffness and muscle weakness which reduces function [7]. Quadriceps inhibition is an impairment of central nervous system results in decreased strength and proprioceptive acuity. Defect in proprioception results in reduced dynamic stability of knee and progressive functional limitation [8,9]

Diagnosis of Osteoarthritis is made with reasonably based on history and clinical examination. X-ray may confirm the diagnosis. Kellegran and lawrence grading system was used commonly for grading knee Osteoarthritis[10,11] and other investigations used for detecting Osteoarthritis are serological tests, ESR, serum uric acid and arthroscopy. [12]

Most of the Osteoarthritis knee subjects are treated conservatively with pharmalogical (Analgesics, non steroidal antiinflammatory drugs, glucosamine and intraarticular hyalurunate injections) [13,14]. Physiotherapy management reduces pain by the use of electromodalities such as TENS, ultrasound, diathermy, cryotherapy [15,16]. Exercises improves function and reduce pain are range of motion exercises, strengthening exercises, stretching of hamstrings, aerobic exercises, agility and perturbation training, retrowalking and Aquatic exercises [17] .

Recent trensds shows that exercise therapy includes Neuromuscular Training [21] and Functional Task Training [22] has been proved effectively in reducing symptoms of Osteoarthritis Knee.

Material and Method

Inclusion criteria: subjects with age 35 – 60 years of both men and women, Able to walk 100 feet without assistive device, Able to ascend and descend stair, Mild to moderate knee OA grade 2, 3 kellegran and lawrence scale**,** Not taking anti inflammatory medication**,** Unilateral involvement of Osteoarthritis knee

Exclusion criteria: Knee surgeries or intraarticular corticosteroid injections**,** Traumatic injury to the knee joint**,** Neurological disease Inability to rise from and return to a chair without assistance, currently participating in any exercise programme**,** Uncontrolled cardio pulmonary conditions

Outcome measures: Hand Held Dynamometer (HHD) [18] used to measure muscle strength at baseline, posttest (end of 8 weeks). **KOOS Questionnaire [19]** used to measure the functional ability and Quality of life at baseline and posttest.

The study was a pretest – posttest prospective cohort study, the subjects are grouped based on sample of convenience and are allocated in Neuromuscular group (n=34) and Functional Task Training group (n=34). Baseline measurements for both groups were taken in the 1st day, after completion of 8 weeks. A brief explaination was also given about the nature and duration of the study and then informed consent was taken. Initial assessment like age, gender, occupation, address, side affected was also taken

Group- I: NEUROMUSCULAR TRAINING

Subjects in group-I received neuromuscular training. This training consists of three parts 1) warming up – cycling for 10 minutes 2) circuit program consists four exercise circles 3) cooling down part for 10 minutes. Training session was given 3 times per week for 8 weeks and it lasts for 60 minutes [21]

Part 2: Circuit program

Four exercise circles are in circuit program, Each exercise is performed by the subject's is 10-15 repetitions, 2-3 sets, with rest, corresponding to one set, between each set and exercise. Three levels of difficulty are given for each exercise that allows for progression.. The exercises are performed with both the affected and the non affected leg, although focus is on the affected leg [21].

Exercise circle 1: Core stability/postural function

This circle includes exercises with focus on core stability and postural function.

Exercises

A. Pelvic-lift with flexed knees and short lever arm, putting load on both legs .

B. Sit-ups with flexed knees, both legs on ball, arms along the sides (short lever arm)

Exercise circle 2: Postural orientation

This circle includes exercises with emphasis on an appropriate position of the joints in relation to each other i.e., with the hip, knee and foot joints well aligned

A. Slide-exercise forward-backward: Standing, weight-bearing on one leg, other leg on sliding surface. Slide backwards – forwards with "sliding leg", while flexing – extending the knee of the weight-bearing leg and keeping an appropriate position of the joints in relation to each other.

B. Slide-exercise sideways: Standing, weight-bearing on one leg, other leg on sliding surface. Slide sideways with sliding leg, while flexing – extending the knee of the weight-bearing leg and keeping an appropriate position of the joints in relation to each other..

Exercise circle 3: Lower extremity muscle strength

This circle includes exercises in open and closed kinetic chains to improve strength of hip and knee muscles.

Exercises

A. Hip abductors/hip adductors: Standing on one leg, rubber band other leg. Pull rubber band out (hip abductors) and in (hip adductors). Make sure there is tension in the rubber band also in resting position. Focus is on the hip abductors of the standing leg, keeping an appropriate position of the joints in the lower extremity in relation to each other and in relation to the trunk, i.e., without lateral displacement of the hip-pelvis region.

B. Knee Extensors/knee Flexors: Sitting position. Rubber band around one foot. Pull rubber band forward (knee Extensors) and backwards (knee Flexors). Make sure there is tension in the rubber band also in resting position.

Exercise circle 4: Functional exercises

This circle includes exercises resembling activities of daily life.

Exercises

A. Chair stands: Start in a seated position, feet parallel, putting load on both legs, slight hand support for balance

B. Stair climbing: Step-up and step-down on low step-board, with or without slight hand support for balance.

Part.3. Cooling down: It consists of walking exercises forward and backwards, about 10 meters in each direction, in front of mirror , mobility exercises for the lower extremities and stretching exercises for the lower extremity muscles for a total of about 10 minutes.

GROUP-II: FUNCTIONAL TASK TRAINING

Subjects In Functional Task Training received five exercises. The subjects were asked to do each exercise for one minute, 3 times per week for 8 weeks. All exercises were supervised by the physiotherapist. Progressions included by increasing the time to perform the activity [22]

Exercises:

1. Sit to stand in a chair Subject is able to perform this exercise by sit to stand from a chair under supervision of physiotherapist. **2**. **Standing star exercise**: Subject performs this exercise in standing position with affected knee placed forward followed by sideward and backward which is in the form of star. **3. Walking up and down a ramp:** Subject perform this exercise on a ramp by walking up and down under supervision of physiotherapist. **4. Ascending and descending stairs**: Subject perform this exercise in stairs by ascending and descending under supervision of physiotherapist **5.Walking indoors:** Subject walk indoors under the supervision of physiotherapist

Findings

Statistical Analysis

All statistical analysis was done by using SPSS software version 20.0 and Microsoft excel-200.

Descriptive data was presented in the form of mean standard deviation and mean difference percentages.

Between the groups: Independent student "t" test was performed to assess the statistical significant difference in mean value between the groups for dynamometer and KOOS score

Within the groups: Paired Student "t" test was performed to assess the statistical difference with in the groups for knee Flexors and knee Extensors and KOOS score (Pain, Symptoms, ADL and QOL) from pretest and post test values.

For all statistical analysis, $p< 0.05$ was considered as statistically significant.

Results

Table 1: Comparision of Post Mean scores in strength and function between the groups

			Mean	Std.Deviation	p- value	Inference
STRENGTH	Knee flexors	Group-I	14.75	2.19	0.0041	Significant
		Group –II	13.23	1.69		
	Knee extensors	Group-I	15.89	2.07	0.0001	Significant
		Group –II	14.2	1.58		
FUNCTION	KOOS Pain	Group-I	46.79	14.30	0.0409	Significant
		Group –II	40.66	11.68		
	KOOS Symptoms	Group-I	55.86	12.19	0.018	Significant
		Group –II	46.76	17.42		
	KOOS ADL	Group-I	50.58	10.84	0.037	Significant
		Group –II	44.16	11.43		
	KOOS QOL	Group-I	44.41	11.02	0.0014	Significant
		Group –II	35.16	9.23		

The above Table shows improvement in Post Mean Group-I and Post mean of Group-II. There is a significant difference between the Groups

Discussion

Aim of the study was to evaluate the effectiveness of Neuromuscular (Group-I) and Functional Task Training (Group-II) on strength and function in subjects with knee Osteoarthritis

In this study subjects were assessed for knee Osteoarthritis underwent either Neuromuscular or Functional Task exercises which are performed for 8weeks, the parameters usually assessed before and after exercise training are knee pain, strength, and function. The following outcome measures named as DYNAMOMETER, and KOOS. These measures are used for quantifying the intensity of strength, pain and function in subjects with Knee Osteoarthritis. There is statistically significance difference between two groups

in improving strength and function in subjects with Osteoarthritis Knee

In this study, the result in Neuromuscular Training is primarly based on sensorimotor system. sensorymotor dysfunction may play a role in development and progression of degenerative knee disease. The aim of the Neuromuscular Training method is to improve sensorymotor system and achieve functional stability [24].

Eva Ageberg et al [25] conducted a study on effects of Neuromuscular Training on patient reported outcomes and physical function in severe primary hip or knee Osteoarthritis and find that Neuromuscular Training with progression and with individualized approach had showed improvement in patient reported outcomes and also physical function in old patients with primary hip or knee Osteoarthritis

Functional Task exercises enhance muscle strength, function and reducing pain in subjects with Knee Osteoarthritis. It is due to complex neural activation and vast muscle mass using multiple joint exercises, neural adaptations and then muscle strength. Similar findings are seen by Paul et al in his study the closed chain exercises (squat) which gives high stability by co contraction of quadriceps and hamstrings provide minimal stress on knee joint in functional range, it is effective and safe exercise method

Similar results are also seen in the study conducted by kk singh et al [26], the effects of Functional Task Training (FTT) versus Progressive Resistance exercises on Osteoarthritis knee and find that FTT is effective in improving balance, functional mobility and reducing pain in Osteoarthritis of knee

Osteoarthritis knee affects the hamstring muscle more than the quadriceps muscle. The ratio of quadriceps to hamstrings muscles strength is important for stability of the knee for protecting from exercise stress. In conclusion, subjects who have knee Osteoarthritis need to improve muscle power, proprioception. We think that designing appropriate exercise programs create effective result [27].

Conclusion

The present study concluded that eight weeks of Interventions of Neuromuscular and Functional Task Training were shown statistically significant in improving strength and function. However Neuromuscular is more effective in improving strength and function when compared with Functional Task Training. Thus we can conclude that Neuromuscular Training is a suitable adjunct to physiotherapy rehabilitation in subjects with knee Osteoarthritis

Conflict of Interest: Nil

Source of Funding: Self

Ethical Clearance: The ethical clearance of this study protocol was approved by the Ethical Committee of GSL Medical College; the participants were requested to provide their consent to participation in the study.

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